

*31*  
*cont'd.*

surface of the diffusion barrier layer is a layer which is relatively thin compared to the central portion of the diffusion barrier layer.

3. (Amended) The diffusion barrier layer of Claim 1 wherein the lower surface of the diffusion barrier layer is a layer which is relatively thin compared to the central portion of the diffusion barrier layer.

*32*

7. (Amended) A semiconductor device comprising:  
a substrate containing conductive elements; and  
a diffusion barrier layer applied to at least a portion of the substrate in contact with the conductive metal elements, the diffusion barrier layer having an upper surface and a lower surface and a central portion, and comprising silicon, carbon, nitrogen and hydrogen, with the nitrogen being non-uniformly distributed throughout the diffusion barrier layer, wherein the central portion is substantially devoid of nitrogen.

8. (Amended) The diffusion barrier layer of Claim 7 wherein the upper surface of the diffusion barrier layer is a layer which is relatively thin compared to the central portion of the diffusion barrier layer.

9. (Amended) The diffusion barrier layer of Claim 7 wherein the lower surface of the diffusion barrier layer is a layer which is relatively thin compared to the central portion of the diffusion barrier layer.

#### REMARKS

This application has been reviewed in light of the Office Action dated May 6, 2002. Claims 1-16 are pending in the application with Claims 1 and 7 being in independent form.

Claims 1-6 and 8-10 were rejected under 35 U.S.C. §103(a) as allegedly being

unpatentable over U.S. Patent Application Publication No. 2002/0020919 (“Li, et al.”) in view of U.S. Patent No. 6,100,559 (“Park”). Claims 7 and 11-16 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Pat. No. 6,228,761 (“Ngo, et al.”) in view of Li et al. and Park.

#### **I. REJECTION OF CLAIMS 1-6 and 8-10 UNDER 35 U.S.C. §103(a)**

Independent Claim 1, in the present application provides a “diffusion barrier layer for semiconductor devices, the diffusion barrier layer having an upper surface and a lower surface and a central portion and comprising silicon, carbon, nitrogen and hydrogen, with the nitrogen being non-uniformly distributed throughout the diffusion barrier layer, wherein the central portion is substantially devoid of nitrogen.”

Independent Claim 7, in the present application provides a “semiconductor device comprising a substrate containing conductive elements, and a diffusion barrier layer applied to at least a portion of the substrate in contact with the conductive metal elements, the diffusion barrier layer having an upper surface and a lower surface and a central portion and comprising silicon, carbon, nitrogen and hydrogen, with the nitrogen being non-uniformly distributed throughout the diffusion barrier layer, wherein the central portion is substantially devoid of nitrogen.”

Li et al. is directed to a diffusion barrier for semiconductor devices, the diffusion barrier including silicon, carbon, nitrogen and hydrogen. Li et al. does not disclose or suggest the nitrogen being non-uniformly distributed throughout the diffusion barrier layer. Li et al. does not disclose or suggest a central portion substantially devoid of nitrogen, as recited in Claims 1 and 7.

Park is directed to a graded silicon oxynitride cap layer in which the concentration of nitrogen varies. Park does not cure the deficiencies of Li et al. That is, Park does not disclose or suggest a diffusion barrier layer having an upper surface and a lower surface and a central portion and comprising silicon, carbon, nitrogen and hydrogen. Furthermore, Park does not disclose or suggest a central portion substantially devoid of nitrogen, as recited in Claims 1 and 7.

Hence, Li et al. and Park, alone or in combination, do not disclose or suggest a diffusion barrier layer having an upper surface and a lower surface and a central portion and comprising silicon, carbon, nitrogen and hydrogen, with the nitrogen being non-uniformly distributed throughout the diffusion barrier layer, wherein the central portion is substantially devoid of nitrogen, as recited in Claims 1 and 7.

Therefore, independent Claim 1 is believed to be patentably distinct over Li et al. in view of Park. Claims 2-6 and 8-10 depend from Claims 1 and 7, respectively, and therefore, for at least the same reasons given for independent Claims 1 and 7, Claims 2-6 and 8-10 are believed to be patentable over Li et al. in view of Park, and the allowance of Claims 1-6 and 8-10 is respectfully requested.

## **II. REJECTION OF CLAIMS 7 AND 11-16 UNDER 35 U.S.C. §103(a)**

Ngo et al. is directed to a semiconductor device having a substrate containing conductive elements and a diffusion barrier applied to at least a portion of the substrate in contact with the conductive metal.

Accordingly, Ngo et al. does not disclose or suggest the diffusion barrier layer having an upper surface and a lower surface and a central portion and comprising silicon, carbon, nitrogen and hydrogen, with the nitrogen being non-uniformly distributed throughout the diffusion barrier layer, wherein the central portion is substantially devoid of nitrogen, as recited in Claim 7. Li et al. and Park do not cure the deficiencies of Ngo et al. for at least the reasons provided above.

Therefore, independent Claim 7 is believed to be patentably distinct over Ngo et al., Li et al. and Park, alone or in combination. Dependent Claims 11-16 depend from Claim 7, and therefore, for at least the same reasons given for independent Claim 7, Claims 11-16 are believed to be patentable over Ngo et al. in view of Li et al. and Park. Accordingly, withdrawal of the rejection as to Claims 7 and 11-16 under 35 U.S.C. §103(a) and the allowance of Claims 7 and 11-16 are respectfully requested.

**V. CONCLUSION**

In view of the foregoing amendments and remarks, it is respectfully submitted that this case, containing Claims 1-16 is in condition for allowance. Such early and favorable action is earnestly solicited.

If the Examiner should have any questions concerning this communication or feels that an interview would be helpful, the Examiner is requested to call the Applicants' undersigned attorney at the number indicated below.

Respectfully submitted,



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**Requirements as per C.F.R. §1.121(c)(1)(ii)**



Marked up claims 1, 2, 3, 7, 8 and 9 showing all changes relative to the original claims.

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1. (Amended) A diffusion barrier layer for semiconductor devices, the diffusion barrier layer having an upper surface and a lower surface and a central portion and comprising silicon, carbon, nitrogen and hydrogen, with the nitrogen being non-uniformly distributed throughout the diffusion barrier layer, wherein the central portion is substantially devoid of nitrogen.
2. (Amended) The diffusion barrier layer of Claim 1 wherein [the nitrogen is more concentrated near] the upper surface of the diffusion barrier layer is a layer which is relatively thin compared to the central portion of the diffusion barrier layer.
3. (Amended) The diffusion barrier layer of Claim 1 wherein [the nitrogen is more concentrated near] the lower surface of the diffusion barrier layer is a layer which is relatively thin compared to the central portion of the diffusion barrier layer.
7. (Amended) A semiconductor device comprising:  
a substrate containing conductive elements; and[,]  
a diffusion barrier layer applied to at least a portion of the substrate in contact with the conductive metal elements, the diffusion barrier layer having an upper surface and a lower surface and a central portion[,] and comprising silicon, carbon, nitrogen and hydrogen, with the nitrogen being non-uniformly distributed throughout the diffusion barrier layer, wherein the central portion is substantially devoid of nitrogen.
8. (Amended) The diffusion barrier layer of Claim 7 wherein [the nitrogen is more concentrated near] the upper surface of the diffusion barrier layer is a layer which is

relatively thin compared to the central portion of the diffusion barrier layer.

9. (Amended) The diffusion barrier layer of Claim 7 wherein [the nitrogen is more concentrated near] the lower surface of the diffusion barrier layer is a layer which is relatively thin compared to the central portion of the diffusion barrier layer.